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HEBER ROBARTS, M.D., M.E., EDITOR.

New York City Business Office, 100 William Street, Room 205. PROF. T. L. BROPHY, Representative.
Chicago Business Office, 87-83 Washington Street, Room 514. DR. FRED W. SPINK, Representative.

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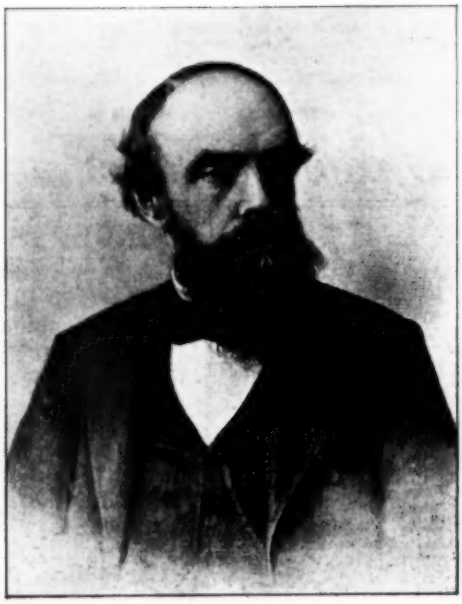

R. J. NUNN, M. D.

The American X-Ray Journal.

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EXCITATION OF THE CROOKES' TUBE BY THE STATIC MACHINE.

BY JOHN T. PITKIN, M. D., BUFFALO, N. Y.

Since the discovery of the utility of the Roentgen ray in the practice of medicine for diagnostic purposes, static machines of many kinds and descriptions have been brought forward as generators of the lightning current employed to excite the Crookes' tube for their production.

Having employed considerable time and means to determine the relative merits of these instruments, let me rapidly pass in review the results of our investigations.

A cheap machine is dear at any price, poor in construction and meager in output, it endangers the patient's body to electrical burns which may even jeopardize his life.

The Toeplar Static Electrical Machine is the easiest to excite and maintain in a state of charge but as this type of instrument often reverses its polarity while in operation it can not be recommended for x-ray work.

Machines containing rubber plates rapidly deteriorate their generating power, becoming less and less by warping and oxidizing of the rubber disks.

The plain Holtz machine, on the other hand, if of adequate size and construction, when properly operated, stands preeminently adapted for the purposes of the expert Roentgenian.

This type of machine, although it requires another instrument to excite its plates into primary action, does not reverse while working, is easily operated by one versed in its requirements and does not necessitate as thorough a knowledge of electricity as does the successful operation of the high tension coil apparatus.

Each pair of revolving plates and their immediate accessories in a Holtz machine may be considered as a separate instrument generating its individual bands or lines of force and that in the complex machine these units or pairs of plates, etc., are connected with each other in multiple harmonic relation.

In the construction of the Holtz machine for x-ray work, the number and size of the revolving glass disks is of prime importance, because the quantity and pressure of the currents are thereby determined. A two-plate machine of a given size will therefore discharge an electrical stream just as far through the atmosphere as an instrument having many times that number, but the amount of current will be very small.

In proof of the foregoing statement let me state that we have in our institution machinery capable of demonstrat-

ing this fact, instruments large and small, good, bad and indifferent.

As we look backwards some three or four years, we recall that the best instruments supplied to us by the standard makers at that time, contained but eight 28-inch revolving plates, giving, under the greatest practical momentum, a ten to twelve-inch spark with about four fibers of force playing between the discharging rods. The estimated voltage from these machines was from one to two millions, but the amperage was very low. Under the most favorable condition of the atmosphere and momentum, the x-rays from such a source may be considered fair, but are unsatisfactory to the expert operator.

About two years ago the manager of the Buffalo Electrical Sanitarium induced one of the standard makers to construct a machine having ten revolving 30-inch disks (the first ever constructed) with the most satisfactory results, because both voltage and amperage of the current were thereby increased and the x-radiation obtained therefrom considerably augmented, for the increase in the size of the revolving plates of a given thickness and quality of glass intensifies the voltage or pressure, while the addition of new plates increases the amperage or quantity of the current.

As a result of this improvement in the capacity of the static machine, over one hundred have been built on our specifications and are now in successful operation throughout the country. But the zenith of perfection of the static machine as a Crookes' tube exciter we are satisfied has not as yet been attained.

Shall we now in order to better the standard machine, increase the number, the size, or both the size and number of the revolvers? If the former plan is pursued the voltage will exceed two millions, will be correspondingly hard to control by insulation and will incompletely short-circuit through the woodwork of the apparatus, even through the air. The danger zone around the tube will be increased in area. With a hard tube in circuit the current will jump from one conductor to conductor of opposite polarity inside of the apparatus or around the tube on the outside. Its severe impact will often puncture the tube just as it has been worked up to a condition of greatest usefulness. To avoid these untoward results, the wheels should not exceed 28 to 30 inches in diameter or else they should be driven at a very moderate rate of speed. Let us rather increase the number of plates, adding two more, making a twelve-plate apparatus.

Having operated the ten-plate machine previously mentioned over two years, we have replaced the same by a new instrument (the first to be built) containing twelve 30-inch revolving wheels. This apparatus has been otherwise modeled to suit all of our whims and fancies. This machine in operation, when driven at a moderate speed, produces a ten to fifteen-inch spark, which is very fat, i. e., has six electrical bands playing between the discharging rods. (All x-ray apparatus giving a long thin spark will prove to be a failure, a delusion and a snare.) In performing x-ray work the new apparatus causes a Crookes' tube as large as a cocoanut to light up at once and maintain a steady, uniform light without flickering or becoming dark, and the x-ray bulbs should last for years under the relatively moderate electrical pressure.

Skiagraphs can be taken through the adult's body at the safe distance of one to two feet, in from one to five minutes. Although we do not consider this machine *ne plus ultra*, having at this early date other specifications in the hands of the makers, still we do consider that it is one more step forward toward x-ray perfection.

ON THE LUMINOSITY OF THE RARE EARTHS WHEN HEATED "IN VACUO" BY MEANS OF CATHODE RAYS.*

BY A. A. CAMPBELL SWINTON.
Communicated by Lord Kelvin, F.R.S.

For incandescent gas mantles it is found that certain definite mixtures of the rare earths are necessary in order to obtain the maximum luminosity. For instance, in the ordinary Bunsen gas flame, a mantle consisting of pure thorium oxide, or of pure cerium oxide, will only give about $\frac{1}{11}$th of the light that is given by a mantle composed of 99 per cent of thorium oxide and 1 per cent of cerium oxide, which is the mixture at present used by the Welsbach Company.

In order to explain this remarkable fact, several different and somewhat contradictory theories have been propunded, one of which implies catalytic or other chemical action between the oxides and the constituents of the Bunsen flame.

In order to investigate this question, it is obviously important to note the behavior of the rare earths at high temperatures without contact with any flame, and endeavors have already been made to effect this by heating the oxides in specially constructed furnaces. Under these conditions, only very minute differences could be detected in the amount of light given by different oxides and mixtures, but it appears doubtful whether the very high temperature of the Bunsen flame was really attained.

It has occurred to the writer, that very high incandescence could be produced by enclosing mantles in a vacuum tube, and subjecting them to bombardment by means of cathode rays, when the mantles would not be in contact with anything except the cathode rays themselves, and the comparatively small amount of residual gas that remains in the tube at the requisite high degree of exhaustion.

Since the date of Sir William Crookes' early researches, it has been known that a very high temperature could be produced in a body placed at the focus of the convergent rays from a concave cathode. In this manner Crookes melted platinum and glass, and brought carbon wool to bright incandescence. The writer has made many experiments on this subject, using instead of the interrupted continuous currents employed by previous investigators alternating electric currents, which appear to have many advantages for this purpose. At the Royal Institution, in February, 1898, the writer showed that very brilliant incandescence could be obtained for a short time in a small block of lime, placed in a suitably exhausted tube midway between two concave electrodes, connected to an alternating electric supply to about 6,000 volts pressure, and in June, 1898, at the Royal Society, he exhibited in action a similar arrangement, but with the block of lime replaced by a flat plate of orium oxide. In this case the concave electrodes were of such a curvature and were placed so far apart, that the two sides of the thorium plate in each case intersected the diverging cone of cathode rays. Under these conditions nearly a square inch of the thoria surface of each side of the plate became highly incandescent, and a very powerful light was obtained for some minutes at a time, but only at a critical and highly unstable degree of vacuum.

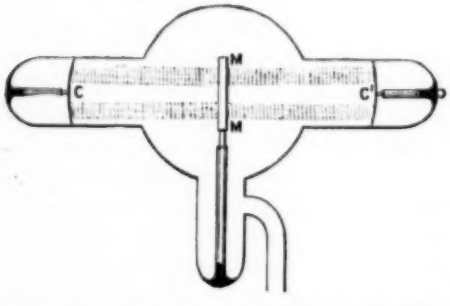
The writer has now applied this method to the investigation of the comparative luminosity of different mixtures of the rare earths.

One form of the tube employed was constructed as shown in fig. 1, where c, c' are two spherically concave discs of aluminum 1·125 inches diameter and 6 inches radius of curvature. These electrodes are placed about 7 inches apart, and were

*Royal Society. Read April 27, 1899.

connected to the secondary terminals of a 10-inch Ruhmkorff coil, the primary of which was supplied through a variable resistance, with alternating electric current at 100 volts pressure from the main. The tube was connected through a drying tube containing phosphorus pentoxide to a pair of Toepler pumps, and also to a McLeod gauge.

The mantle, M M, to be experimented upon was mounted on a platinum wire frame, and placed between the two electrodes, so that as the electric current alternated, and each electrode became in turn cathode, the mantle was subjected on alternate sides to cathode ray bombardment. The curvature of the electrodes was such as to give almost parallel beams of cathode rays, so that a considerable ring shaped and slightly hol-



low area on each side of the mantle was subjected to the rays, and could be brought to high incandescence.

A preliminary experiment was made with a mantle of asbestos, powdered over in patches with pure thorium oxide. With this it was found that at a suitable degree of exhaustion, the patches of thoria became brilliantly incandescent, with an intensity of cathode rays that made the asbestos barely red hot.

Experiments were next made with mantles consisting entirely of thoria and ceria, both separately, and mixed in different proportions. These mantles were prepared in a similar manner to the Welsbach incandescent gas mantles, by saturating a carefully purified cotton fabric with ammonium nitrate of thorium and cerium, and then burning out the cotton. Very thick and closely woven cotton lamp wick, freed from foreign matter by treatment with caustic soda, hydrochloric acid, and ammonia, was employed in place of the thin fabric usually used, so that the resulting mantle, after burning out the cotton, was very close in texture, and fully 0·2 inch thick. This was found necessary, as otherwise some of the cathode rays passed through the mantle and melted the opposite aluminum electrode.

In order to obtain accurate comparisons between pure oxides and different mixtures, the mantles were made in patchwork, each complete mantle being made up of two or four sections, separately impregnated with different solutions, and then sewn together with impregnated cotton before being burnt.

The mantles were so mounted in the vacuum tube that the cathode rays impinged equally upon the portions that consisted of different mixtures, so that an equal amount of energy was imparted to each sample.

With a compound mantle prepared in this way, composed one-half of pure thorium oxide, and the other half of a mixture of 99 per cent thorium oxide plus 1 per cent of cerium oxide, it was found after exhaustion that on starting the cathode discharge the thoria plus ceria heated up to incandescence more rapidly, and on stopping the discharge, cooled more rapidly than the pure thoria. Further, when at full incandescence, and observed through a dark glass, the thoria plus ceria was slightly more luminous than the pure thoria, though the difference was very small—probably not more than 5 per cent. Owing to the difficulty of obtaining a constant vacuum, accurate photo-metrical measurements were not possible, but the amount of light under favorable conditions was roughly estimated at, at least,

150 candle-power per square inch of incandescent surface, this being obtained with an expenditure of electrical energy in the secondary circuit at about 8,000 volts pressure of approximately 1 watt per candle. The amount of exhaustion suited to give the best results varied with the dimensions of the tube and the conditions mentioned below, but was approximately about 0·00005 atmosphere, the maximum luminosity being obtained when the dark spaces of the two cathodes just crossed at the center of the bulb. Owing to the large amount of gas occluded by the mantle, a proper degree of permanent exhaustion was very difficult to arrive at, and required continuous pumping for many hours with the cathode rays turned on at intervals. Even then the condition of maximum luminosity were exceedingly unstable, owing to the further liberation of occluded gas on the one hand, and on the other to the rapid increase in the degree of exhaustion owing to absorption of the residual gas by the electrodes. That such absorption probably took place in the aluminum electrodes, and not in the mantle, was demonstrated by other experiments with a tube in which there was no mantle, but only two electrodes of aluminum wire.

After the cathode rays had been allowed to bombard the mantle for a short time, the latter was found to have become discolored where bombarded. That portion which was composed of pure thoria became dark blue, while the thoria plus ceria became brown. This effect, which appears to be analogous to those observed by Goldstein with lithium chloride and sodium chioride,* seems to be due to a partial reduction of the oxides by the cathode rays. The admission of a very minute quantity of air to the tube while the cathode rays are acting on the mantle, and the latter is in parts incandescent, causes the discoloration to disappear instantaneously on the incandescent, but not upon the cool portions, probably by re-oxidation of the partially reduced oxides, while the discoloration also slowly vanishes in a day or two with the mantle cold if air at ordinary atmospheric pressure is admitted to the tube. By continuing to bombard the mantle with cathode rays, and alternately allowing the vacuum to increase and letting in small quantities of air, the discoloration can be made to appear and disappear over and over again as often as desired. At the moment of admitting the air, the amount of light was found momentarily to increase, this being probably due to the increased temperature due to the re-oxidation of the partially reduced oxides.

After repeating this process of letting in small quantities of air, and allowing them to be absorbed several times, it was found that the degree of exhaustion which gave the maximum incandescence had altered from 0 000047 to 0 000112 atmosphere, as measured by the McLeod gauge. Similar effects were obtained with a tube containing no mantle, but only aluminium wire electrodes, the inference being that some change takes place in the residual gas which renders it less conducting.

At a higher degree of exhaustion than that which produced incandescence of the mantle, the pure thoria was found to fluoresce blue, and the thoria plus ceria with a yellowish light. The fluorescence in each case was much less bright when the oxides were white than when they had become discolored by previous bombardment. With very high exhaustions the thoria plus ceria fluoresced the more brightly; at lower exhaustions the pure thoria gave the brighter fluorescence.

On the suggestion of Mr. W. Mackean, the tube was pumped up to a very high vacuum and oxygen admitted. A similar experiment was made with hydrogen, the tube being completely filled with the gas, and then pumped to the proper de-

*Wied Ann., 1895, No. 54, p. 371.

gree of exhaustion. Though at low exhaustions these gases gave distinctive appearances to the discharge in the tube, no difference in the behavior of the mantles with them and with air could be detected when once the vacuum reached the degree required for producing incandescence of the mantle.

Further experiments were made with a similar tube containing a compound mantle made up of four sections, composed as follows: (1) pure ceria, (2) pure thoria, (3) 50 per cent thoria, 50 per cent ceria, (4) 99 per cent thoria, 1 per cent ceria.

With an intensity of cathode rays that gave a brilliant light with Nos. 2 and 4, Nos. 1 and 3 were found to give practically no light, becoming barely red hot; while, as before, No. 4 was found to give slightly more light than No. 2, and to heat more rapidly and to cool more rapidly than the latter.

These experiments show that thoria and ceria, both alone and mixed behave quite differently when heated by cathode ray bombardment than when heated in a Bunsen flame. In the latter 99 per cent thoria, plus 1 per cent ceria, gives many times as much light as pure thoria alone, while when incandesced by cathode rays of equal intensity the difference, though in a similar direction, is exceedingly small. Again, in the flame pure ceria gives just about the same amount of light as pure thoria, while with a given intensity of cathode ray bombardment, thoria gives a brilliant light while ceria gives practically none.

In arriving at any finally satisfactory theory of the luminescent properties of the rare earths, these results with cathode rays, which differ materially from those obtained by other methods of heating, will require to be taken into account.

I am indebted to the courtesy of the Welsbach Incandescent Gas Light Company for the sample of the rare earths with which the above investigations were made; also to the assistance of Mr. J. C. M. Stanton and Mr. H. Tyson Wolff in carrying out the experiments.—*Electrical Review*, London.

Diffraction of Roentgen Rays.

Maier.—An account of a series of experiments made to determine the wave length of Roentgen rays by means of diffraction. In the course of an investigation made for the same purpose, Fomm had used a linear source of Roentgen rays, a slit parallel to it, and a screen behind the slit, on which he detected two systems of fringes, one on each side of the slit, and one system in the image itself In trying to repeat this experiment Maier used every variety of focus tube and altered the elements of the arrangement in every conceivable manner, but without success; but when he used ordinary Crookes or Hittorf tubes, he obtained the fringes sought, or rather the first minimum within the image. From his measurements he calculated the wave length to be about a thirtieth of the wave length of ordinary light, which is good agreement with Fomm's figures.—*Wied. Ann.*, No. 8; abstracted in Lond. *Elec.*, Aug. 25. *Elect. W. and Eng.*, N. Y.

Instantaneous Radiographs.

Caldwell.—A short illustrated article on experiments performed to obtain good radiographs with very short exposures, varying from a single discharge to one second. He did not employ any new or unusual methods, but used very efficient tubes and exciting apparatus and developed the negative with care. The exciting apparatus consisted of a good oil-insulated induction coil, capable of delivering a 12 or 14-inch spark, and a Caldwell interrupter giving about 34 breaks per second. The negatives were made on celluloid films, which laid face down upon a tungstate calcium screen.—*Elec. Rev*, July 26.

Foreign Bodies in the Eyeball Located by X-Rays.

Dr. Hansell, at a recent meeting of the Section on Ophthalmology, College of Physicians, Philadelphia, detailed the case of a young man shot through the right eye. The x-rays located the shot in the orbit slightly posterior to the globe. Under expectant treatment the inflammation subsided, and the eye remained quiescent for several weeks. Then symptoms of sympathetic irritation developed, and the injured ball was enucleated. Upon examination the shot was found lodged in the optic nerve. This case seems to substantiate the claims made recently that sympathetic ophthalmia may arise from injury directly to the nerve, and be conveyed by means of the lymph channels of the optic nerve to the tract, and thence to the sound eye. But it must be remembered that in most cases, as in this one, the anterior structures have been seriously damagad, and the origin of the sympathetic involvement may well be the ciliary region, universally admitted to be the "danger zone."

Dr. Harlan reported a case of "Splinter of Iron in the Eyeball," with iritis and hypopion, located by the x-rays and removed with the electromagnet. A machinist was struck in the right eye by a chip of iron from a cold chisel nine days before he presented himself at Wills' Eye Hospital. Although suffering considerable pain and loss of vison, he had simply bound up the eye and continued his work. He had a small scar near the temporal border of the cornea, in the equator of the ball, iritis with posterior synechia and hypopion, and haziness of the lens preventing a view of the fundus. In the middle of the outer half of the iris, behind the corneal scar, a small bead of lymph seemed to hide a penetrating wound, and streaks of opacity, extending from the temporal to the nasal side of the lens, suggested that a spiculum of iron had passed through it and lodged in the fundus. Dr. Leonard, of the University laboratory, reported that a long, narrow splinter of iron was lodged just behind the iris, transfixing the margin of the lens. An incision five or six mm. long was made through the cicatrix in the cornea, and the large, blunt electrode of a Hirschberg magnet was applied against it externally, when an iron splinter ten mm. long and one mm. wide was promptly extracted. Ice was applied for a few days, and the patient left the hospital with the eye nearly quiet and no other disability than a cataractous lens. Attention was called to the fact that the lens and vitreous afford the most favorable field for the removal of foreign bodies by the magnet after the lapse of considerable time, as they do not become involved in dense cicatricial tissue, as when lodged in the choroid. The skiagraph was shown of another case in which a chip of iron was found after enucleation, imbedded in the choroid near the optic disk, where it had been for three weeks. It was so firmly encased in scar tissue that the magnet had no effect when applied directly, and quite a tedious dissection with scissors points was necessary to release it. It is not probable that it could have been dislodged even by a Haab magnet.

Dr. de Schweinitz read the notes of a case of "Foreign Body in the Lens Located with Roentgen Rays," a piece of steel which had remained quiescent for nearly four months (the lens being partially cataractous), which was accurately located by the x-ray according to Dr. W. M. Sweet's method. When the pupil was widely dilated, this piece of steel could be seen in the upper part of the lens, but could not be seen when the pupil had returned to its natural size. In other words, the localization with the ophthalmoscope and with the x-rays

was identical, and the case was presented as an admirable demonstration of the value of Sweet's method.

Roentgen Rays in Dental Surgery.

Dr. William Rollins of Boston, in the *Electrical World and Engineer* has written briefly on the use of the Roentgen rays in dental surgery and illustrated the interesting article with plates and camera used in diagnosis. He says:

In Mr. Rice's article in the *Electrical World and Engineer* of April 22, it is stated that the application of Roentgen rays to dental surgery has been until recently little realized or developed. I take exception to this statement, as within a few weeks of Roentgen's announcement, I had constructed cameras to go into several of the internal cavities of the human body, including the mouth and they have been used for visual and photographic work by my friends and myself. They were duly described in hospital reports and dental and medical journals at the time. Beautiful work has also been done by Dr. Dwight M. Clapp, of Boston, on the teeth. He has shown various pathological and traumatic conditions of the roots. Dr. J. Edmund Kells, Jr., of New Orleans, has also published results, and has taken photographs of the teeth in which the exposure was reduced from minutes to seconds.

I have used the method as part of my routine work for three years, and have discovered several conditions of the teeth which could never have been known without it. For example, I have found that the so-callen Riggs' disease does not begin at the surface, as was believed, but that the first symptom is an absorption of the edge of the sockets. In fact, the use of Roentgen's discovery by the most progressive men in dentistry is constant.

Mr. Rice describes a method for photographing the teeth, which consists in taking an impression of the mouth in wax, and then trimming to a flat surface for the film to rest on and replacing the impression with the film in the mouth to take the picture. This takes more time and is otherwise inferior to my old method, some details of which are shown in the accompanying illustrations.

The oral camera is mounted on a ball joint, and has an aluminum window attached to a screw cap that can be removed to put in the celluloid films. There should be six of these. This multiple method is the invention of Prof. Elihu Thomson, and is of great value. I have changed it a little by putting between the films thin sheets of some partly "non-radiable" material so as to give each film a slightly different exposure. In this way the results on the average are better. All these instruments have been in practical use for three years.

The use of cameras and fluoroscopes for the internal cavities has been pretty well exploited, and as there is so much to learn in this field, no one can afford to duplicate old results. This is my reason for writing this, and which I hope Mr. Rice will pardon as not being intended in a critical spirit.

Dr. Rollins makes use of a camera for the rectum or vagina which takes strips of celluloid films. The sheath is made of aluminum which is transradiable and at the same time waterproof and opague to ordinary light. The oral camera consists of a soft rubber bag and opague to ordinary light and containing half a dozen celluloid films. It is closed water tight.

There are sliding metal tubes to adjust the eye distances and for transforming the Lenard-Roentgen light into ordinary light.

Radiography, With Special Reference to Detection of Renal Calculi.

C. Mansell Moullin.—*Lancet*, May 27.—The author speaks of the difficulty of radiography when photographing structures that lie deep in the tissues, such as renal and biliary calculi. He thinks it better to make thorough examination with the fluorescent screen before attempting to make the photograph. When both methods are used the screen tells a great deal more to the skilled observer than does the photographic plate. He is not prepared to say that this advantage of the screen over the plate will be permanent, as the art is still so immature. As regards the use of the coils or static machines for x-ray work, he considers it impossible to make any definite statement, but he speaks very highly of the Wimshurst apparatus. An advantage of this is that the current from it is quite harmless, and if the patient should get into the circuit no serious damage could be done, while a similar accident with the coil would be exceedingly inconvenient. Within the last few weeks, however, the use of a new principle — the Wehnelt electrolytic break—has greatly increased the power of the coil and enables us to obtain results previously impossible. As regards the renal calculi, the condition of the patient and the composition of the stone are both matters of importance. If the patient is thin and the calculus of oxalate of lime, positive results can usually be obtained. Phosphatic calculi are harder to detect and those of uric acid or urates still more so. If the patient is stoutly built and muscular, success is less certain. He thinks, however, with the use of the Wehnelt interrupter, better results will be obtained. In difficult cases such as these every endeavor must be made to reduce the thickness of the tissues by purgatives or enemata. The position of the patient is also a matter of importance. The erect position fixes the object better, but crowds the liver down in front and increases the antero-posterior diameter of the body. Moullin prefers to have the patient recumbent with the back well arched, and the light passed through in both directions, with a screen or plate used both in front and behind. To prevent movement of the calculus, from respiration, the patient is directed to hold his breath as long as possible and the exact distension of the thorax noted. Then he is allowed to breathe until he has recovered himself and then directed to hold his breath a second time with the thorax in the same state of distension. This is repeated as often as necessary, the light being only switched on during the period of apnea, when the thorax is at rest and the kidneys and the calculi are presumably occupying the same position relatively to the light. As regards biliary calculi, they are still more difficult, owing to their very low absorptive index. The difficulty is greatest when inflammation is most wanted, that is, when the calculus is not in the gall-bladder but in the ducts and when the patient is stout and the abdomen firm.

Potential Gradient at the Anode in Vacuum Tubes.

Skinner.—An investigation of the potential gradient within the luminous layer of 1 to 2-mm thickness covering and closely adhering to the anode. Both Hittorf and Graham (Digest, March 26, 1898,) had found that there is a sudden fall of potential between the metallic anode and the gas amounting to about 20 volts and increasing to about 40 volts within the first few millimeters. Skinner proves that the potential gradient within the luminous layer is infinitesimal, and that the greater the potential drop at the anode, the thicker is the anode layer. The anode drop depends upon the gas, the pressure and the material of

the anode; it has the greatest values for those metals which exhibit the least difference of potential when used as cathodes.—*Wied. Ann.*, No. 8; abstracted in London *Elec.*, Aug. 25; *Elect. W. and Eng.*, N. Y.

Injury From Vacuum Tube.

Dr. Philip Mills Jones, of San Francisco, in the *Pacific Record*, gives five reasons to controvert the ideas set forth by Alfred C. Prentice, on the cause of x-ray dermatitis. His reasons are:

1. Dermatitis may result from an exposure to the radiant energy emitted from an excited vacuum tube.

2. We have a large, comparatively, amount of radiant energy being absorbed by certain structures.

3. We know that every change in energy will result in dermatitis in these tissues. (Either absorption or dissipation, for burn will result from heat or cold.)

4. It is at least possible that this absorption of energy by the skin cells may so modify the cells that they die, thus producing the necrosis which is known to be a feature of the dermatitis R.

5. That electrification, consequent or incidental to exposure in the neighborhood of a conductor carrying a high potential, either when the circuit is open or when it is closed, will produce any irritation, or any dermatitis R, has not been demonstrated, and in fact such an assumption is in direct opposition to the facts thus far noted by many observers.

Electrostatic Lines of Force.

Boccara.—Smearing the terminals of a discharge gap with a liquid such as castor oil, is a good method of showing the lines of force in the gap; the spray flies between the terminals in such a way as to demonstrate the direction of the lines of force.—*Nuovo Cimento* 8, p. 406; noticed in *Science Abstracts*, June.

Prof. Roswell Park makes the startling prophecy that if for the next ten years the present relative death rates are maintained, in 1909 there will be more deaths in the State of New York from cancer than from consumption, smallpox, and typhoid fever combined.—*Western Medical Review.*

It appears from the following, by Dr. Massey, of Philadelphia, on "The Cataphoric Treatment of Cancer," that the relative death rate will not be maintained:

Since the paper previously read before the section, 26 cases of carcinoma and sarcoma had been subjected to this method of treatment in some manner, many of them extremely bad cases—some forlorn hopes. Of these cases 10 were operable cases and these resulted as follows: Cured, 8; probably cured, 1; failed to be cured, 1. Of the inoperable cases there were cured, 2; probably cured, 1; failed to be cured, 13. He concluded as follows:

"(1) The massive diffusion of nascent mercuric salts within a growth of the body by an electric current constitutes a novel therapeutic procedure of great value in the destruction of foci of malignant or non-malignant germ growths when said growths are so situated as to permit of penetration and drainage.

"(2) This cataphoric destruction of the germs of a primary cancerous growth *in situ*, including outlying colonies and so-called roots of prolongation, permits the preservation of the unaffected portions of the organ in which it is situated, and offers greater security against a recurrence of the growth than efforts to remove the living malignant organisms by cutting operations.

"While the cataphoric method may be employed as a palliative in non-operable malignant growths and may at times cure them, its chief value is in the total destruction of the malignant germs in the early stages of primary growths and in the same stages of purely local recurrences."

X-Rays In the Transactions of the N. Y. Surgical Society.

At a State meeting of the Transactions of the New York Surgical Society, Dr. Curtis showed an x-ray picture of a fractured patella with pseudarthrosis which had been treated by wiring. An x-ray photograph was also shown of a cross-union of the radius and ulna. Dr. Curtis showed a radiograph which was misleading. The x-ray picture which revealed, apparently, a pin in the esophagus. The patient was a child who had swallowed a hat-pin, about two inches long, with a glass head. An unsuccessful attempt was made to locate the pin by the aid of the fluoroscope. An x-ray picture was then taken which apparently revealed a thin, dark body, like the shaft of the pin, in the esophagus. The picture proved to be deceptive, however, as the pin was recovered shortly afterwards in the stools, and the supposed pin was a defect in the gelatin of the plate—but not a mere scratch on the surface which could easily have been recognized. The case illustrates the necessity for care in the interpretation of the x-ray negatives.

Electrical Exhibition.

Each of the Electrical Exhibitions held in New York City of late years has been distinguished by some special feature. That of 1896 included the best public demonstration of the Roentgen rays, the transmission of power from Niagara, and the sending of a cable message around the world. The Exhibition of 1898 included a complete church, lit by vacuum tubes; the application of electricity to street-car traction, the first series of wax works ever made to illustrate the history of an art, the theatrophone, and the beginnings of wireless telegraphy. In 1899 the prominent feature was certainly antimobilism. Wireless telegraphy occupied a prominent place. Several valuable government exhibits were attractively displayed. They included apparatus from the Army and Navy, the Signal Corps and the Weather Bureau. A special department was devoted to electro-therapy.

Impersonation.

The discovery of the x-ray has been much to my advantage, for in substance I am so much more dense than my fellows that they have not yet succeeded in making me transparent, and the shadows which I cast in a skiagraph discloses my outlines perfectly, whereas there is not another one of the human shapes with which I am connected that enjoys this distinction. When any of my bones are broken, or diseased, or out of place, surgeons are able to find it out now much quicker and more surely than before, and consequently I am able to obtain more speedy relief than formerly.

I am just as proud as my brother tissues, for I am an indispensable member of the family, and what affects them affects me, and, on the other hand, whatever affects me I can tell you affects them also. In fact, when I am really in trouble and enter my complaints at headquarters, I always command a hearing, and very little other business can be attended to until my wrongs are righted.

Extracted from "Series of Impersonations," by Dr. E. H. Pratt.

A New Radio-Active Substance.

De Haen.—By extraction from a large quantity of uranium ore, he has obtained substances which possess the properties ascribed by Curie (Digest, Feb. 4,) to "radium," in an extraordinary degree. Two preparations have been made; one exhibits the properties of Becquerel rays, it excites fluorescence in a barium platino cyanide screen even across opaque substances, effects the photographic plate, makes air electrically conducting, and is itself strongly luminous. For the other

preparation the excitement of the screen is more intense, whereas the self-luminosity is feebler. Both must be carefully protected from moisture.—*Wied. Ann.*, No. 8; abstracted in Lond. *Elec.*, Aug. 25; *Elect. W. and Eng*, N. Y.

The Value of the X-Rays in Detecting Small Renal Calculi.

Dr. Robert Abbe read a paper with the above title before the Transaction of the New York Surgical Society.

Dr. Parker Syms said that all surgeons appreciated the value of radiography in the diagnosis of renal stone when the picture gave a positive result. There are cases, however, where the clinical symptoms strongly point to the presence of stone, and in which the result of an x-ray picture is absolutely negative. The speaker asked Dr. Abbe what weight he attached to such negative results in the face of strong clinical symptoms.

Dr. Abbe replied that if a good x-ray picture, displaying ribs and spine well (perhaps corroborated by a second one), failed to show the presence of a stone in the kidney, he felt well satisfied that there was no stone of any size there.

Lost X-Rays.

Though the fluorescent screen is very faintly luminous, the Rev. Alexander Moffat finds that if the Roentgen rays were continuous instead of intermittent, they would exert an effect 500 times greater than sunlight falling perpendicularly upon a surface. Only four per cent of the energy impinging upon the screen is represented by the visible radiations, while the interval between two x-ray discharges is about 1,000 times the period covered by a discharge itself. A Georgia inventor, it may be noted, has produced a Roentgen ray lamp, which is claimed to yield an intense light from the bombardment of a covered magnet core by the cathode rays.—*Electricity*, London.

Photography in Natural Colors.

Light being now considered a mode of electricity, a remarkable invention in photography by Prof. Wood of Wisconsin, may be looked upon as coming within the field of electrical interest. Prof. Wood, by the application of purely scientific methods, appears to have at length solved the problem of photography in natural colors. Negatives of the three primary colors are taken, as in the Ives' process; but in printing from these negatives, a diffraction grating, with a definite spacing for each color, is superimposed on the negative. The printing from all three negatives is combined to produce a single positive transparency. When this transparency is viewed through a slit at the focus of the lens which concentrates the light, the object is seen in its true natural colors, which far surpass in brilliancy anything hitherto produced. Obviously these color photographs can be multiplied by the ordinary process of contact printing.—*Electrical Review*, London.

Electric Discharge in a Magnetic Field.

Broca.—He describes experiments from which he concludes that there are two sets of cathode rays, one which follows the helix around the direction of the lines of force, while the other follows the direction of the lines of force. His experiments support the views of Crookes as to the nature of cathode rays; they seem to consist of assemblages of molecules identified with those of luminous sources.—*Jour de Physique*, 7, p. 710; noticed briefly in *Science Abstracts*, June.

X-Ray Examinations in Tuberculosis.—Williams reports several cases of the use of the x-ray in the diagnosis of pulmonary disease and, while not giving up other methods, strongly urges its employment as of value in detecting certain early abnormal conditions. He thinks the danger of x-ray burns is

slight, if it exists at all when proper precautions are taken.—*Jour. Am. Med Ass.*

Effect of Currents on the Human Body.

Kath.—An abstract of a paper read before the Union of German Elec. Eng. There are two kinds of effects; the first is due to large currents, from two to seven amperes, and at high voltage, 1,000 to 2,000, the contacts with the body being good, as in the electrical chair used with condemned criminals in New York State; in such a case the nerve centers are definitely destroyed. The second kind of effect is due to currents from ten to a hundred times smaller, and death is then the result of a shock to the lungs; in this case, the victim can be saved if he receives proper attention promptly. Moist hands or feet, especially if the moisture contains acid, are of course especially dangerous. —*Elek. Anz.*, June 18.

Dr. Levison, in a most interesting article, has provided us with suggestions as to the diagnosis between rheumatoid arthritis and gout by the x-rays, and as to the treatment of the gouty joints by the electrolytic method. Thus electricity, which had long been known to be of considerable use, whether in the shape of the electric bath or of the constant current directly applied to the limb in cases of rheumatoid arthritis, has now found a yet more direct application in gout, since it addresses itself to the removal of the material which is the source of local irritation and pain.—Extracted from an original paper "On the Relation of Gout to Rheumatoid Arthritis," by Dr. Wm. Emart, London. Full text in *International Med. Magazine.*

Chemical Effects of X-Rays.—When photographic plates that have been exposed to the action of x-rays are afterwards exposed to light, the image undergoes reversal in the same way as if both exposures had been made to light, and the precise character of the phenomena depends on the relative magnitudes of the exposures. Plates exposed for some time to x-rays show increased sensitiveness to the less refrangible rays. An interesting communication on this subject was recently made by P. Villard in the *Comptes Rendus Hebdomadaires des Seances de l' Academie des Sciences*, Paris, Vol. 128, pages 237—239.

Energy Consumed in Vacuum Tubes.

Ebert.—Results of some measurements which support the view that the luminous phenomena in vacuum tubes are due to dissociations brought about by the cathode rays impinging on the gaseous molecules; the greater the valency of the molecule the greater the amount of energy required in its dissociation.—*Wied. Ann.* 3, p. 608; abstracted with some data in *Science Abstracts*, May.—*Electrical World and Engineer*, N. Y.

The X-Rays.

The reducing property of cathode rays has been shown by M. Villard to be due to hydrogen, the conclusion being reached, moreover, that the rays from the cathode are formed entirely of hydrogen. This suggests the novel plan of restoring exhausted vacuum tubes by passing gas through a heated platinum plate in the tube wall—such diffusion having been shown by Deville to take place rapidly.—*Electricity*, London.

Radiography in Pregnancy.—Varnier (*Ann. de Gyn. et. d' Obstet.*, April, 1899) reports his experiments on a number of living women and cadavers with the x-ray, to determine the presentation positon and posture of the fetus. This he accomplishes satisfactorily, after 6½ month's gestation. The fetal spine and extremities remain invisible, however. He first obtained a satisfactory contour of the fetal skull on February 13, 1899. —*International Med. Mag.*

The Application of the Roentgen Ray in the Diagnosis and Treatment of Coxalgia.

Josseraud (*Lyon Med.*, No. 46, 1898) has fully demonstrated the value of this method of diagnosis in the determination of the exact condition present in cases of Coxalgia, and the beneficial influence which it has had upon the treatment in these cases. He has shown that the skiagraph will demonstrate the presence of osseous lesions and detect sequestra, making it possible to determine the exact condition of the bone and the situation of the lesion, so that if it is simply cartilaginous, or in the incipient stage, it can be treated by extension and rest, while the presence of any grave osseous lesion makes it possible to operate and remove the sequestrum or diseased area of bone before symptoms are present that would indicate it under other circumstances.—*International Medical Magazine.*

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INTERFERENCE OF CATHODE RAYS.—Descriptions of experiments by means of which the author endeavored to measure the speed of propagation of cathode rays. By one method he found it to be the hundred and fiftieth part of the speed of light and by another the three hundredth. He continues to maintain that cathode rays are longitudinal vibrations.—Jaumann. *Sitz. Ber. Akad. Wissensch. Wein.*, 107, Part 2; abstracted, with illustrations, in the *Elek. Zeit.*, May 25.

CANAL RAYS.—Descriptions of an investigation made to study this phenomenon.—Wehnelt. *Wied. Ann.*, 67, page 421; abstracted, with illustrations in *L'Eclairage Elec.*, May 27.

ROENTGEN RAYS IN SURGERY.—A brief summary of recent progress in the application of Roentgen rays in surgery.—Lond. *Elec. Rev.*, June 2.

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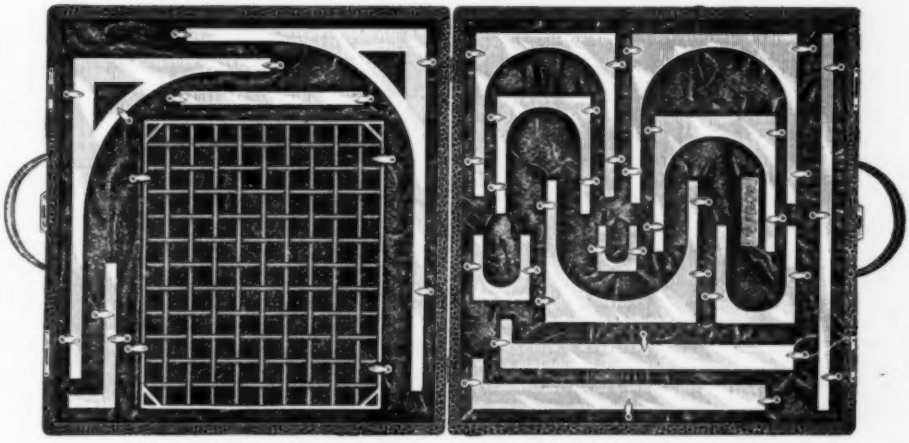

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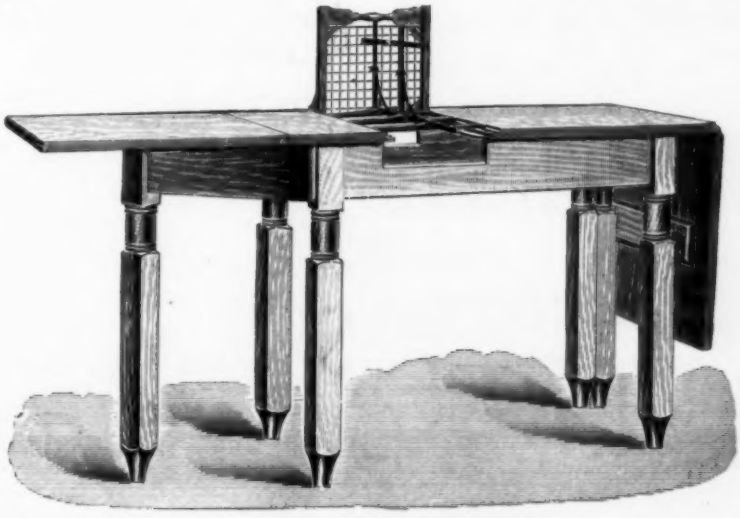

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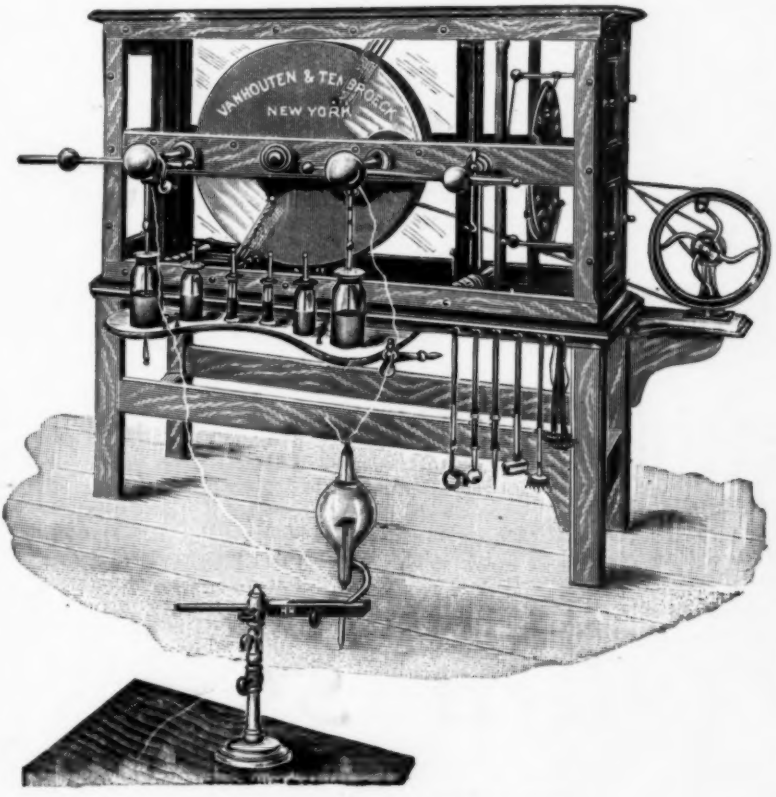

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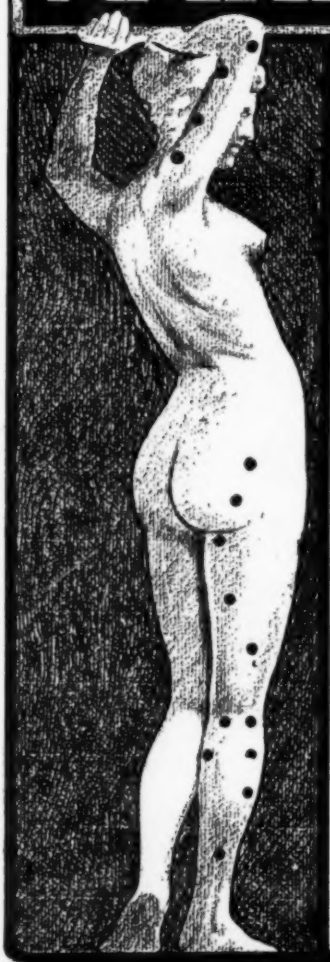

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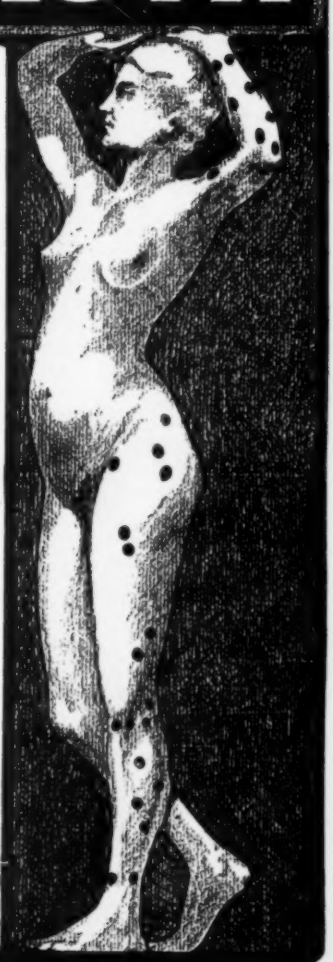

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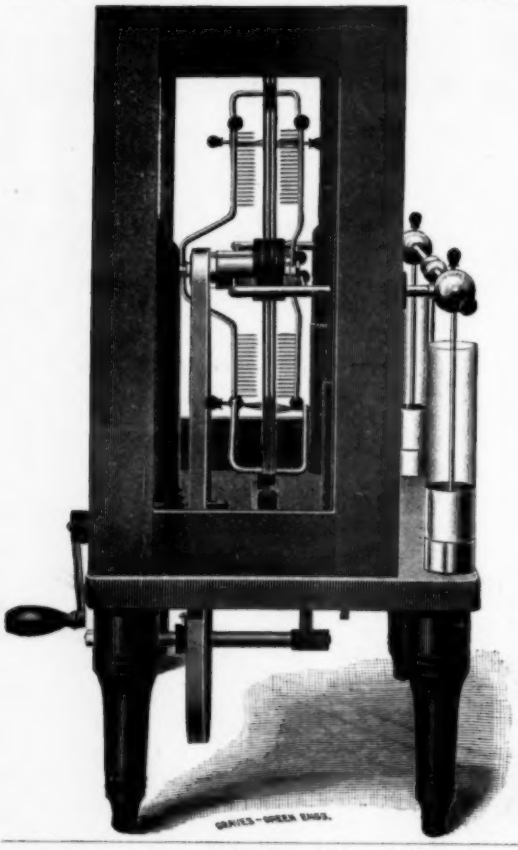

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